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# EFFECTS OF 1973 FLOODWATERS ON PLANKTON POPULATIONS IN LOUISIANA AND MISSISSIPPI

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*ABSTRACT* Studies to assess the impact of floodwater diversion on plankton populations in coastal waters of Mississippi and Louisiana were conducted from 23 April 1973 through 13 July 1973. Fixed stations in Lake Pontchartrain, Lake Borgne and western Mississippi Sound were sampled once in April, twice in May and June, and once in July. Stations in Terrebonne Parish, Louisiana were visited once in May, June and July.

Data are presented on changes in the species composition of zooplankton subsequent to the opening of the Bonnet Carré and Morganza floodways. The hydrographic conditions at the time of sampling are discussed.

## INTRODUCTION

The Bonnet Carré and Morganza floodways serve to divert floodwaters from the Mississippi River to the Gulf of Mexico (Figure 1). The Bonnet Carré Floodway, located 25 miles above New Orleans, empties floodwaters into Lake Pontchartrain. The Morganza Floodway, 280 miles above Head of Passes on the Mississippi River and operating in conjunction with the Atchafalaya Basin Floodway, carries floodwaters to the Gulf by way of the lower Atchafalaya River and Wax Lake Outlet. Severe flooding in the lower Mississippi River valley and prolonged periods of local rainfall necessitated the operation of the floodways in the spring of 1973.

Opening of the Bonnet Carré Floodway began on 8 April with all gates open by 11 April. The floodway remained fully open until 30 May with all gates closed by 11 June. Opening of the Morganza Floodway occurred on 17 April with varying numbers of bays open until 15 June when all bays were closed. Studies to assess the impact of floodwater diversion on plankton populations were begun subsequent to the opening of the two floodways. Data in this report include plankton samples collected from 23 April 1973 through 13 July 1973.

## MATERIALS AND METHODS

### Field Procedure

Daytime samples of surface plankton were taken from 23 April 1973 to 13 July 1973 at stations 1 through 16 (Figure 2). These stations were visited once in April, twice in May and June , and once in July. Stations 17 through 23 in Terrebonne Parish were visited once in May, June and July (Figure 3). A plankton net with a mouth opening of 12 inches and mesh aperature of 193 microns was pulled at a constant speed for an interval of 10 minutes. The samples were preserved in the field in a 5% solution of formalin.

Salinity and temperature of the surface water were measured when each sample was collected. Determinations of temperature and salinity were made with a Beckmen salinometer (Model RS5–3).

### Laboratory Procedure

The volume of plankton (in ml) for each sample was determined by allowing the sample to settle in a graduated cylinder. Samples with settled volumes exceeding 5 ml were aliquoted with a Folsom plankton splitter. Samples with large numbers of the ctenophore *Mnemiopsis mccradyi*, or samples containing excessive debris, were examined in their entirety.

## AREA DESCRIPTION

Areas affected by the diversion of floodwaters through the Bonnet Carré Floodway included Lakes Pontchartrain and Borgne and the western sector of Mississippi Sound. The eastern end of Lake Borgne and the western sector of Mississippi Sound were also influenced by runoff from the Pearl River system. Floodwaters from the Morganza Floodway affected portions of Terrebonne Parish. Eighteen collecting sites were established in the Bonnet Carré outlet area and seven in Terrebonne Parish. Station locations are shown in Figures 2 and 3. To facilitate discussion of data, stations were grouped by geographic location into five areas (Table 1). Discussion of hydrographic and biological data will be by these areas.

## AREA I

Two stations were located in area I in eastern Lake Pontchartrain (Figure 2, Table 1).

Bottom types along the south shore of the lake from the Rigolets to Irish Bayou are predominantly clayey silt (Barrett 1976). Vegetation surrounding this part of the lake is brackish marsh comprised mainly of wiregrass (*Spartina*

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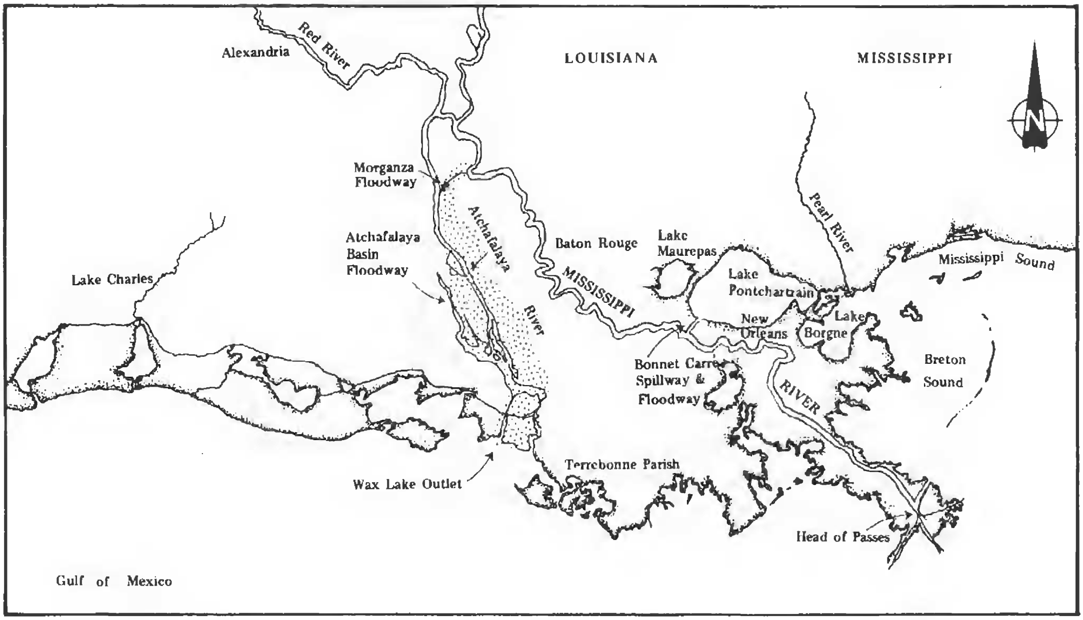


Figure 1. Location of the Bonnet Carré and Morganza floodways.

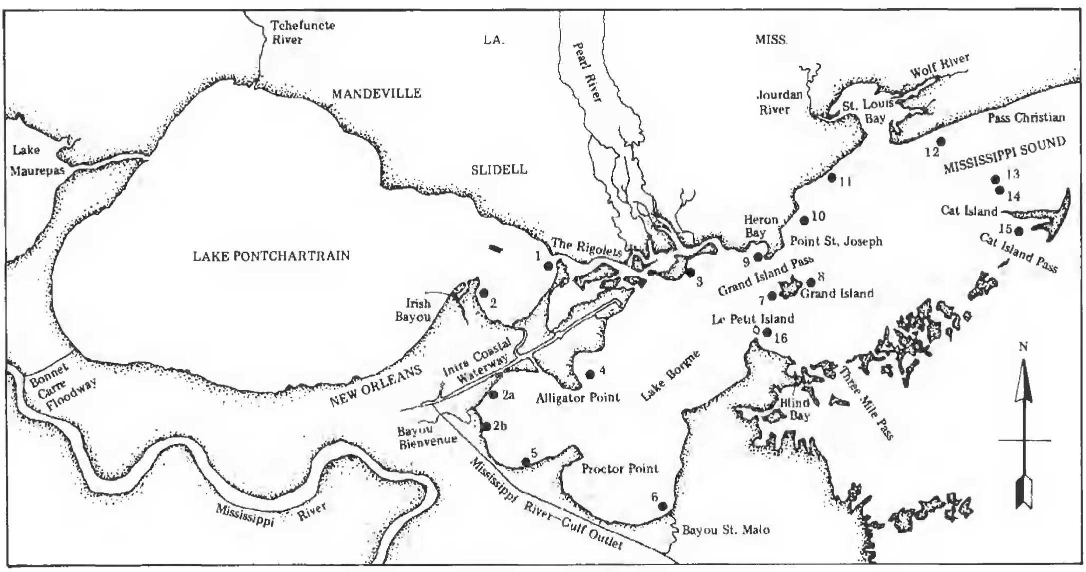


Figure 2. Location of stations 1 through 16.

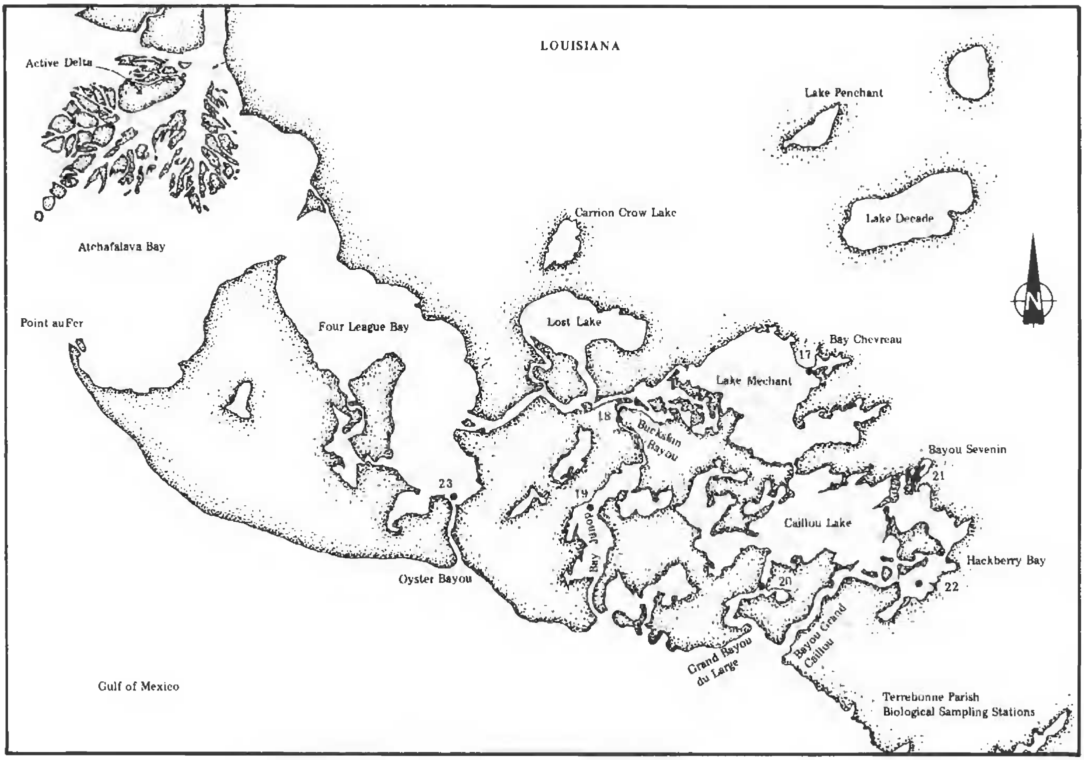


**Figure 3. Location of stations 17 through 23 in Terrebonne Parish, Louisiana.**

**TABLE 1.**

**Station locations.**

| | |
|---|---|
| Area I | stations 1 and 2 in eastern Lake Pontchartrain |
| Area II | stations 2A, 2B, 4, 5 and 6 in western Lake Borgne |
| Area III | stations 3, 7, 8, 9, 10 and 16 in eastern Lake Borgne and extreme western sector of Mississippi Sound |
| Area IV | stations 11, 12, 13, 14 and 15 in western Mississippi Sound |
| Area V | stations 17, 18, 19, 20, 21, 22 and 23 in Terrebonne Parish |

*patens*). Saltgrass (*Distichlis spicata*), oystergrass (*Spartina alterniflora*), coco (*Scirpus robustus*), black rush (*Juncus roemerianus*) and hogcane (*Spartina cynosuroides*) are also present (Chabreck 1972). Submerged vegetation is abundant near Irish Bayou, with tapegrass (*Vallisneria americana*) and widgeongrass (*Ruppia maritima*) both occurring. Tapegrass also exists along the north shore of the Rigolets. Water depths average 6 to 8 feet; near the entrance to the Rigolets the depth is 45 feet.

*Hydrographic Data*

*Salinity*. The hydrology of Lake Pontchartrain is greatly influenced by wind speed, wind direction and runoff of the rivers in the Pontchartrain basin; tidal fluctuations play a lesser role (Tarver and Savoie 1976). Darnell (1962) gives an average salinity of 5.0 ppt for the lake with fluctuations from 3.0 to 8.0 ppt as normal. He notes extremes of 1.2 and 18.6 ppt following heavy rainfalls and tropical Gulf storms, respectively. The studies of Stern et al. (1968), Barret et al. (1971a) and Tarver and Dugas (1973) support Darnell's data.

Surface salinities for stations in area I from April through July 1973 are shown in Table 2.

During and subsequent to the opening of the floodway, salinities dropped from 1.3 ppt to below 1.0 ppt for the sampling period. Tarver and Savoie (1976) also found salinities in the lake dropped during the 1973 opening of the floodway, decreasing from 1.5 ppt in April to 0.3 ppt in June, and rising in July to 7.4 ppt.

Salinities following the flood of 1973 were below average during the spring and summer of 1974, 1975 and 1976 (Tarver and Savoie 1976; U.S. Army Corps of Engineers 1974–1976).

TABLE 2.

Hydrographic data and settled volume of plankton for stations in area I.

| Station | Parameter | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| 1 | ppt | 1.3 | 0.0 | 0.2 | 0.3 | 0.2 | 0.0 |
| 2 | ppt | 0.3 | 0.0 | 0.0 | 0.0 | 0.2 | 0.3 |
| 1 | °C | 22.1 | 23.5 | 26.5 | 29.1 | 29.2 | 30.7 |
| 2 | °C | 22.0 | 22.2 | 24.9 | 27.2 | 29.6 | 30.0 |
| 1 | ml | *1.0 | *1.0 | *1.0 | 1.0 | 30.0 | *1.0 |
| 2 | ml | *1.0 | 2.0 | *1.0 | *1.0 | 40.0 | *1.0 |

*less than

*Temperature.* Surface temperatures in area I from April through July 1973 are shown in Table 2. Temperatures during this period were within the normal range for area I as reported by Tarver and Dugas (1973) and Tarver and Savoie (1976).

#### *Biological Data*

*Settled Volume.* The settled volume of plankton by station in area I is shown in Table 2. Eight of the twelve samples were under 1.0 ml in settled volume. The high settled volumes in the second June samples included copepods, cladocerans and large quantities of debris.

*Zooplankton.* A systematic list of zooplankton collected in area I is presented in Table 3. Published data on plankton in Lake Pontchartrain include: Wilson 1958; Suttkus et al. 1953–55; Darnell 1958, 1959, 1961, 1962; Bowman 1965; Stern et al. 1968; Stern and Stern 1969; Tarver and Dugas 1973 and Tarver and Savoie 1976.

Species diversity and abundance in our samples were low through May, increased greatly in June, and returned to low levels in July. Estuarine endemic species in area I included the copepods *Acartia tonsa, Eurytemora affinis, Eurytemora hirundoides, Halicyclops fosteri* and the meroplanktonic larvae of benthic invertebrates. Adventitious freshwater plankton occurred in the first May samples and in both June samples.

*Rhithropanopeus harrisii* zoeae were frequently occurring organisms, dominating the April and May samples. Zoeae of this species have not been reported from Lake Pontchartrain, although Darnell (1959) noted larvae that "may have been" *R. harrisii*, abundant and widespread in the lake during April and May at low salinities. Darnell (1959, 1961, 1962) reported large endemic populations of *R. harrisii* adults in the lake, and Cali (1972) found adults of this species common in the City Park pond system in New Orleans. Stern et al. (1968), Stern and Stern (1969) and Tarver and Dugas (1973) all reported decapod zoeae and/or larvae from the lake from May through July. Tarver and Savoie (1976) reported decapod larvae to be the primary component of plankton samples from their two stations in area I. The present study is the first report of *Uca* sp. larvae in the lake, although Darnell (1959) reported adult *Uca* sp.

Copepods were rare until June when species diversity and abundance increased dramatically. When copepods occurred in numbers, the species composition was unusual, the near absence of *A. tonsa* being most notable. All previous investigators reported *A. tonsa* to be the primary component of the plankton of the lake. During June 1973, copepods characteristic of fresh water (*Diaptomus, Cyclops* and *Mesocyclops*) were common to abundant. This is the first report of these three genera in Lake Pontchartrain. Estuarine endemic copepods occurring in the present study, *E. affinis, E. hirundoides* and *H. fosteri*, have been previously reported from the lake by Suttkus et al. (1953–55), Wilson (1958), Tarver and Dugas (1973) and Tarver and Savoie (1976).

Freshwater cladocerans, particularly species of *Diaphanosoma, Moina* and *Bosmina*, dominated the plankton during the second June samples. They were present in small numbers at the time of the first June samples. Suttkus et al. (1953–55), Stern et al. (1968) and Stern and Stern (1969) recorded limited numbers of *Bosmina longirostris*. Small numbers of estuarine-marine cladocerans, *Evadne* sp., *Podon* sp. and *Penilia avirostris*, were found by Tarver and Dugas (1973). In addition, Tarver and Dugas (1973) and Tarver and Savoie (1976) reported unidentified cladocerans from the lake. In the latter study, 99% of the unidentified cladocerans were taken in Lake Maurepas and at the mouth of the Tchefuncte River at salinities of 0.0 to 1.4 ppt. The present study is the first report of large numbers of freshwater cladocerans in eastern Lake Pontchartrain. These populations apparently represent washout from freshwater areas via the Mississippi and Pearl rivers. Large rivers such as the Mississippi normally have limited planktonic populations (Dotson 1966) but during high water, washout from quieter waters dramatically augments these populations. Bryan et al. (1974) reported cladocerans to be the most abundant zooplankters in the lower Atchafalaya basin. Cyclopoid copepods were the second most abundant organisms in their study. The freshwater cladocerans and copepods found in the present study are the same species as found by the above authors to be characteristic of freshwater areas in coastal Louisiana.

The meso-oligohaline amphipods *Gammarus mucronatus* and *Corophium louisianum* and the euryhaline species *Monoculoids edwardsii* were present in April. An unidentified species of *Corophium* occurred in June. Tarver and Dugas (1973) reported *G. mucronatus* and *Corophium* sp. from the lake. A limited number of isopods were noted during the present study. *Edotea* sp. has been reported by

Table 3.

Systematic list of zooplankton, area I.

| Species | Stage | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| Pelecypoda | JUV* | 3 | | | | | |
| *Modiolus demissus* | | 4 | | | | | |
| Polychaeta | LAR | 4 | | | | | |
| Ostracoda | | | 1 | | 1 | | 1 |
| Calanoida | COP | | | | | 3,008 | |
| Calanoida | | | | | | 768 | |
| *Acartia tonsa* | | | 1 | | 25 | 64 | 19 |
| *Eurytemora hirundoides* | | | | | | 128 | |
| *Eurytemora affinis* | | 2 | 2 | | 18 | 64 | |
| *Diaptomus* sp. | | | 5 | | 96 | 5,888 | |
| Cyclopoida | COP | | | | | 192 | |
| Cyclopoida | | | | | | 800 | |
| *Mesocyclops* sp. | | | | | 20 | 32 | |
| *Halicyclops fosteri* | | | | | 5 | | |
| *Cyclops* sp. | | | | | 50 | 96 | |
| *Ergasilus* sp. | | | | | | 60 | |
| *Argulus* sp. | | | | 1 | 6 | 64 | 2 |
| Cirripedia | NAU | | | | 1 | | 1 |
| Amphipoda | | 1 | | | 1 | | |
| *Gammarus mucronatus* | | 1 | | | | | |
| *Corophium louisianum* | | 2 | | | | | |
| *Corophium* sp. | | | | | 5 | | |
| *Monoculoides edwardsii* | | 1 | | | | | |
| *Cassidinidea lunifrons* | | | 2 | | | | |
| *Edotea* sp. | | | | | 1 | | |
| Mysidacea | ZOE | | | | | 32 | |
| Caridea | ZOE | | 8 | 2 | 73 | | 2 |
| *Rhithropanopeus harrisii* | ZOE | 280 | 864 | 42 | 670 | | 17 |
| *Uca* sp. | ZOE | | | | 12 | | 1 |
| *Callinectes sapidus* | JUV | | | 1 | 5 | 8 | 1 |
| *Diaphanosoma brachyurum* | | | | | 49 | 264,544 | |
| *Daphnia* sp. | | | 2 | | 3 | | |
| *Simocephalus vetulus* | | | 2 | | 15 | | |
| *Simocephalus exspinosus* | | | 2 | | | | |
| *Moina* sp. | | | | | | 171,520 | |
| *Moina micrura* | | | | | 160 | 224 | |
| *Bosmina coregoni* | | | | | | 17,536 | |

**TABLE 3 – Continued**

| Species | Stage | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| *Bosmina longirostris* | | | | | 1 | 384 | |
| *Sida crystallina* | | | | | | 64 | |
| *Moinodaphnia macleayii* | | | | | 10 | | |
| Insecta | | | | P** | | | |
| Anisoptera | | | | P | | | |
| *Tendipes* sp. | | | | P | | | |
| Osteichthyes | LAR | 42 | 5 | 12 | 167 | | 68 |
| *Syngnathus* sp. | JUV | | | 1 | | | |
| *Najas guadalupensis* | | | | | P | | |
| Lemnaceae | | | | | P | | |
| *Lemna* sp. | | | P | P | P | P | |
| *Spirodela oligorhiza* | | | | P | | | |
| *Spirodela* sp. | | | P | | P | P | |
| *Wolffia columbiana* | | | P | P | P | P | P |
| *Wolffiella floridana* | | | P | P | P | | |

*Abbreviations for stages of development in Tables 3, 5, 7, 9 and 11 are as follows:

| | | | |
|---|---|---|---|
| COP | Copepodid | MED | Medusa |
| EGG | Eggs | MEG | Megalopa |
| HYD | Hydroid | NAU | Nauplius |
| IMM | Immature | NYM | Nymph |
| JUV | Juvenile | OPH | Ophiopluteus |
| LAR | Larva | PRO | Protozoea |
| LEP | Leptocephalus | PST | Postlarva |
| MAS | Mastigopus | ZOE | Zoea |

**The letter "P" indicates occurrence in the sample without counts to show relative abundance.

Tarver and Dugas (1973) while this paper is the first published report of *Cassidinidea lunifrons* in Lake Pontchartrain.

*Summary Area I.* Previous studies of eastern Lake Pontchartrain suggest a planktonic community dominated by estuarine species with the meroplankton composed of the larval stages of *R. harrisii* and the holoplankton dominated by *A. tonsa*. The other major components were adventitious oligohaline and marine forms. Plankton samples in April and May 1973 were characteristically estuarine species dominated by the larvae of *R. harrisii*. In late June this community was replaced by freshwater-oligohaline species, primarily cladocerans and copepods. From May through June the presence of floating vascular plants such as duckweed (*Lemna* sp.) and watermeal (*Wolffia columbiana*) indicated the continuance of riverine washout.

### AREA II

Four stations were located along the shores of Lake Borgne from Alligator Point to the mouth of Bayou St. Malo (Figure 2, Table 1). Stations 2A and 2B were added to the study in June.

Bottom sediments in the center of Lake Borgne are primarily clayey silt, with silty clay present in some areas along the shore (Barrett et al. 1971b). The marshes adjacent to Lake Borgne are brackish and dominated by wiregrass (*Spartina patens*); some saltgrass (*Distichlis spicata*) is also present (Chabreck 1972). Water depths in the lake range up to 9 feet (Barrett et al. 1971a).

#### *Hydrographic Data*

*Salinity.* Salinities in Lake Borgne at the time of construction of the Mississippi River–Gulf Outlet canal ranged from 1.5 to 6.0 ppt (el Sayed et al. 1961). After completion of the Gulf Outlet in 1968, salinities in Lake Borgne were substantially higher (personal communication, Johnny Tarver, Louisiana Wildlife and Fisheries Commission). With few exceptions, Tarver found the minimum salinity values for eastern Lake Borgne for April and May 1969–1972 exceeded the maximum value recorded by el Sayed et al. (1961). In April of 1970, Tarver recorded a high salinity of 17.7 ppt.

Surface salinities for stations in area II from April through July 1973 are shown in Table 4. With the exception of station 6 in April and station 5 in June, salinities were below 3.0 ppt until July. Stations 2A, 2B and 5 showed a rise in salinity as more saline conditions returned. Salinities at station 6 were highest in April. The geographic location and influence of the Mississippi River–Gulf Outlet canal may account for this.

Postflood data from Bayou Bienvenue and Alligator Point, supplied by personnel of the Louisiana Wildlife and Fisheries Commission, indicated that in a normal year, salinities increase during the period April through July. April salinities in 1974–75 ranged from 1.0 to 5.8 ppt while July salinities ranged from 4.4 to 17.0 ppt.

Surface temperatures for stations in area II from April through July 1973 are shown in Table 4. The lowest reading occurred in early May at station 5 and the highest occurred during the second June sampling at stations 4 and 6. In general, temperatures were within the ranges recorded by el Sayed et al. (1961) and the Louisiana Wildlife and Fisheries Commission.

#### *Biological Data*

*Settled Volume.* The settled volume of plankton by station in area II is shown in Table 4. No sample was received from station 2A for the first June sampling. Of the 23 samples collected, 19 had settled volumes under 1.0 ml.

*Zooplankton.* A systematic list of zooplankton collected in area II is found in Table 5. Papers describing the zooplankton of eastern Lake Borgne include el Sayed et al. (1961) and Cuzon du Rest (1963), who sampled during the construction of the Gulf Outlet canal and Gillespie (1971) who sampled after its completion.

Both el Sayed et al. (1961) and Cuzon du Rest (1963) found *Acartia tonsa* to be dominant in Lake Borgne. *Eurytemora hirundoides* was the second most common plankter. Cyclopoid copepods and cladocerans were also characteristic of these low-salinity (less than 3.0 ppt) waters. Decapod zoeae were reported, but in exceedingly low numbers (adult *Rhithropanopeus harrisii* were present). Gillespie (1971) found a typically estuarine plankton community with *A. tonsa* the principal species. The seasonal intrusion of marine species such as *Oncaea mediterranea* and *Undinula vulgaris* was noted. Freshwater organisms were conspicuously absent from her samples.

During the opening of the floodway in 1973, the plankton population of area II was composed of estuarine and freshwater species. Zoeae of *R. harrisii* were present in large numbers at each station. Limited numbers of *Uca* sp. and *Sesarma* sp. larvae were present from May through July. A few amphipods occurred. *Acartia tonsa* dominated the holoplankton, with large numbers of this estuarine species present in April, June and July. The freshwater component was dominated by ten species of cladocerans. Five of the six cladoceran genera found in the present study were reported by Chien (1969) in a study of the cladocerans of the Pearl River system. Some freshwater cyclopoids, such as *Diaptomus* sp. and *Cyclops* sp., were present mainly in June. Insects and/or floating plants were present at each sampling, indicating the continuing washout from fresh water. Representatives of the freshwater group Conchostraca were found during the

Table 4.

Hydrographic data and settled volume of plankton for stations in area II.

| Area | Parameter | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| 2A | ppt | | | | 0.2 | 0.2 | 2.6 |
| 2B | ppt | | | | 0.4 | 1.9 | 9.8 |
| 4 | ppt | 0.9 | 0.5 | 0.2 | 1.7 | 0.6 | 0.7 |
| 5 | ppt | 0.9 | 0.3 | 0.4 | 0.5 | 3.2 | 10.0 |
| 6 | ppt | 4.5 | 1.3 | 1.6 | 1.7 | 2.7 | 2.3 |
| 2A | °C | | | | 27.8 | 29.9 | 30.0 |
| 2B | °C | | | | 28.9 | 30.6 | 30.8 |
| 4 | °C | 24.3 | 25.1 | 26.1 | 29.1 | 32.6 | 32.9 |
| 5 | °C | 24.0 | 23.4 | 25.8 | 28.6 | 30.0 | 30.8 |
| 6 | °C | 24.4 | 23.8 | 27.2 | 29.4 | 32.6 | 32.2 |
| 2A | ml | | | | | *1.0 | *1.0 |
| 2B | ml | | | | *1.0 | *1.0 | *1.0 |
| 4 | ml | *1.0 | *1.0 | *1.0 | 7.0 | 3.0 | 1.0 |
| 5 | ml | *1.0 | *1.0 | *1.0 | *1.0 | *1.0 | *1.0 |
| 6 | ml | *1.0 | *1.0 | *1.0 | *1.0 | 7.0 | *1.0 |

*less than

Table 5.

Systematic list of zooplankton, area II.

| Species | Stage | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| Coelenterata | | | | | 20 | | |
| Ctenophora | | | | | | | |
| *Beroe* sp. | | | | | | | 1 |
| Pelecypoda | LAR* | | 10 | | | | |
| *Tagelus divisus* | | 1 | | | | | |
| *Tellina* sp. | | 1 | | | | | |
| *Brachidontes recurvus* | | 1 | | | | | |
| Gastropoda | LAR | 1 | | | 3 | | |
| Polychaeta | | 1 | | | | 1 | |
| Polychaeta | LAR | | | | | 1 | |
| *Nereis* sp. | | 1 | | | | 2 | |
| Arachnida | | | | | | 1 | |
| Hydracarina | | | | | | 6 | |
| Ostracoda | | | | | 2 | 27 | 4 |
| Copepoda | NAU | | | | | 3 | |
| Calanoida | NAU | | | | | 515 | |
| Calanoida | COP | 12 | | | | 69 | 2 |
| *Acartia tonsa* | | 742 | 3 | 10 | .185 | 312,813 | 363 |
| *Eurytemora affinis* | | | 1 | | 1 | 8 | |
| *Diaptomus* sp. | | 1 | | | 5 | 103 | |
| *Cyclops vernalis* | | | | | 10 | | |
| *Cyclops* sp. | | 1 | | | | 20 | |
| *Ergasilus* sp. | | | | | | 3,458 | |
| *Argulus* sp. | | 1 | | 5 | 14 | 22 | 9 |
| Cirripedia | NAU | 1 | | | 15 | 101 | |
| *Melita nitida* | | | 1 | | | | |
| *Gammurus mucronatus* | | | | 1 | | | 1 |
| *Corophium louisianum* | | | | | 1 | 16 | |
| *Corophium lacustre* | | | | | | 1 | |
| *Corophium* sp. | | | | | | 1 | |
| *Cerapus* sp. | | 3 | | 3 | | | |
| *Aegathoa oculata* | | 2 | | | | | |
| Mysidacea | ZOE | | | | 3 | | |
| Caridea | ZOE | 58 | 61 | 19 | 38 | 10 | 24 |
| *Callinectes sapidus* | JUV | | | | 8 | 4 | 4 |
| *Rhithropanopeus harrisii* | ZOE | 3,329 | 844 | 636 | 4,232 | 877 | 2295 |
| *R. harrisii* | MEG | | | | | | 5 |
| *Uca* sp. | ZOE | | | 1 | 49 | 56 | |
| *Sesarma* sp. | ZOE | | | 1 | 75 | | 1 |
| Conchostraca | | | | | | 9 | |
| *Diaphanosoma brachyurum* | | | | 2 | 145 | 3,151 | |
| *Daphnia* sp. | | 2 | | 1 | | | |
| *Moina micrura* | | | | 1 | 2 | 901 | |
| *Moina affinis* | | | | | 3 | | |

TABLE 5 – Continued

| Species | Stage | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| *Moina macrocopa* | | | | 2 | | | |
| *Moina brachiata* | | | | | 110 | | |
| *Moinodaphnia macleayii* | | | | | 1 | | |
| *Simocephalus vetulus* | | | | | | 24 | |
| *Bosmina coregoni* | | | | | | 187 | |
| *Bosmina longirostris* | | | | | | 142 | |
| Insecta | | | | | | | P** |
| Hemiptera | JUV | | | | | P | |
| Corixidae | NYM | | | P | | | |
| *Trichocorixa* | | | P | | | | |
| *Hydropsyche* | LAR | | | | | | |
| Osteichthyes | EGG | | | | 5 | | |
| Osteichthyes | LAR | 60 | 5 | 19 | 1,088 | 25 | 24 |
| *Anchoa mitchilli* | JUV | | | | 13 | 1 | |
| *Anchoa mitchilli* | | | | 1 | | | |
| *Syngnathus scovelli* | | | | | 2 | | |
| *Syngnathus* sp. | JUV | 1 | | | | | |
| *Myrophis punctatus* | | 1 | | | | | |
| Atherinidae | | | | | 107 | | |
| Gobiidae | | | | | 14 | | |
| *Hyporhamphus unifasciatus* | | | | | 1 | | |
| *Spirodela* sp. | | | | P | | | |
| *Lemna* sp. | | | | | P | | |
| *Wolffia columbiana* | | | | P | P | | P |
| *Wolffiella floridana* | | P | | P | | | |
| *Coscinodiscus* sp. | | P | P | P | | | |

*See Table 3
**See Table 3

second June sampling.

*Summary of Area II.* Both el Sayed et al. (1961) and Cuzon du Rest (1963), sampling during the construction of the Gulf Outlet canal, identified *A. tonsa* as the most abundant zooplankter, with freshwater copepods and cladocerans present. Cuzon du Rest (1963) found the plankton of eastern Lake Borgne characterized by fresh or brackish organisms. Gillespie (1971), sampling after completion of the Gulf Outlet, found the plankton of eastern Lake Borgne to consist almost entirely of the copepod *A. tonsa*; but the freshwater organisms found in the earlier studies were noticeably absent. She found plankton in the area to be primarily estuarine with the occasional intrusion of marine species. Plankton samples taken during the opening of the floodway in 1973 more closely resembled those taken prior to completion of the Gulf Outlet with *A. tonsa* abundant and freshwater copepods and cladocerans common.

## AREA III

Six stations were located in area III, one station near the mouth of Lake Borgne and five stations in the extreme western sector of Mississippi Sound (Figure 2, Table 1). No sample was taken from station 16 in Lake Borgne in April.

Bottom sediments in this area are primarily clayey silt or sandy silt. Submerged vegetation is sparse. Emergent vegetation in eastern Lake Borgne includes oystergrass (*Spartina alterniflora*), saltgrass (*Distichlis spicata*), black rush (*Juncus roemerianus*), and wiregrass (*Spartina patens*). *Juncus roemerianus*, and *Spartina alterniflora* dominate the marshes of the Mississippi coastline and are the predominant marsh type on Grand Island. Water depths are shallow and range from 2 to 10 feet with depths of 38 feet in Grand Island Pass.

### *Hydrographic Data*

*Salinity.* Preflood surface salinities in area III from Three Mile Pass and Blind Bay, Louisiana, for the months of April through July 1968 ranged from 9.9 to 15.5 ppt and 7.5 to 14.3 ppt, respectively (Barrett et al. 1971a). Barrett et al. (1971a) note that salinities in this area are relatively low as a direct result of freshwater drainage from Lake Pontchartrain and Pearl River, and that salinities tend to correlate inversely with discharges from Pearl River. Hydrographic data collected in western Mississippi Sound near Point St. Joseph and Grand Island in 1968 record surface salinities ranging from 3.3 to 19.0 ppt from April through July. Christmas and Eleuterius (1973) consider this region of Mississippi Sound as part of the Pearl River estuarine system. They found a yearly mean surface salinity of 12.2 ppt in 1968. They also noted that salinities in this area were considerably lower than those in other Mississippi estuarine systems though seasonal trends were similar.

Surface salinities for stations in area III from April through July 1973 are shown in Table 6.

At the time of the April sampling, surface salinities in area III ranged from 0.0 to 4.2 ppt, the highest readings taken at stations 7 and 8 near Grand Island. With the exceptions of the first May sample and second June sample at station 16, when salinities were 1.2 ppt, surface salinities at stations in this area did not rise above 0.5 ppt from May through June. Salinities at all stations rose in July with high values of 6.8 and 8.4 ppt recorded at stations 8 and 10, respectively.

Isohalines (5.0 ppt increments) drawn for area III in the year following the 1973 flood were generously provided to the authors by Mr. Johnny Tarver of the Louisiana Wildlife and Fisheries Commission. All stations were within the 5.0 ppt isohaline in April and May. In June the 5.0 ppt isohaline shifted northward to include only stations 3, 9 and 10, with stations 7, 8 and 16 falling in the 10.0 ppt isohaline. By July, with the exception of station 16, all stations were again within the 5.0 ppt isohaline.

TABLE 6.

**Hydrographic data and settled volume of plankton for stations in area III.**

| Station | Parameter | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| 3 | ppt | 0.1 | 0.0 | 0.3 | 0.1 | 0.2 | 0.3 |
| 7 | ppt | 4.2 | 0.3 | 0.2 | 0.2 | 0.2 | 1.2 |
| 8 | ppt | 4.2 | 0.4 | 0.2 | 0.3 | 0.5 | 6.8 |
| 9 | ppt | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 3.3 |
| 10 | ppt | 0.1 | 0.0 | 0.1 | 0.2 | 0.2 | 8.4 |
| 16 | ppt | | 1.2 | 0.0 | 0.3 | 1.2 | 1.8 |
| 3 | °C | 23.7 | 21.9 | 24.7 | 27.7 | 29.9 | 32.0 |
| 7 | °C | 23.2 | 23.1 | 25.3 | 29.5 | 29.8 | 29.9 |
| 8 | °C | 23.8 | 24.7 | 26.1 | 29.1 | 30.8 | 30.3 |
| 9 | °C | 23.6 | 22.8 | 29.5 | 29.9 | 30.8 | 29.7 |
| 10 | °C | 23.5 | 25.4 | 27.2 | 29.9 | 32.0 | 30.3 |
| 16 | °C | | 24.5 | 26.0 | 29.1 | 31.2 | 30.5 |
| 3 | ml | *1.0 | *1.0 | *1.0 | *1.0 | *1.0 | *1.0 |
| 7 | ml | *1.0 | *1.0 | *1.0 | *1.0 | *1.0 | *1.0 |
| 8 | ml | *1.0 | 1.0 | *1.0 | *1.0 | 4.0 | *1.0 |
| 9 | ml | *1.0 | *1.0 | *1.0 | 2.0 | 1.0 | *1.0 |
| 10 | ml | 1.0 | *1.0 | *1.0 | 4.0 | *1.0 | *1.0 |
| 16 | ml | | 9.0 | *1.0 | *1.0 | 2.0 | *1.0 |

*less than

*Temperature.* Surface temperatures for stations in area III from April through July 1973 are shown in Table 6.

Temperatures between stations showed the greatest monthly variations in May with differences of 3.5 and 4.8°C for the two sampling periods, respectively. The lowest reading was taken during the first May sampling effort at station 3 (21.9°C), with the highest readings (32.0°C) observed at station 10 in late June and station 3 in July.

### *Biological Data*

*Settled Volume.* Settled volume of plankton by station in area III is shown in Table 6.

Settled volume of plankton was less than 1.0 ml in 27 of the 35 samples. The highest settled volume (9.0 ml) occurred at station 16 during the first May sampling and was associated with numerous larval fish and large numbers of the zoeal stage of the crab *Rhithropanopeus harrisii.*

*Zooplankton.* A systematic list of zooplankton collected in area III is found in Table 7. The authors were unable to find published data on the seasonal distribution and abundance of zooplankton in the eastern Lake Borgne—western Mississippi Sound area. Butler (1952), during and subsequent to the opening of the Bonnet Carré Floodway in 1950, made collections with a fine mesh net (No. 20) and

TABLE 7.

Systematic list of zooplankton, area III.

| Species | Stage | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| Coelenterata | HYD* | | | 3 | | | |
| Pelecypoda | LAR | 3 | 1 | | 8 | 3 | |
| *Modiolus* sp. | | 3 | | | | | |
| *Brachidontes recurvus* | | 3 | | | | | |
| Gastropoda | LAR | | | 1 | 77 | 98 | |
| Polychaeta | | | | 1 | | | |
| Polychaeta | LAR | 12 | | | | | |
| *Nereis* sp. | | 6 | | | | | |
| Oligochaeta | | | 1 | | | | |
| Hirudinea | | | | | | 3 | |
| Arachnida | | | | 1 | | | |
| Hydracarina | | | 3 | 2 | 4 | 15 | 2 |
| Ostracoda | | 1 | | | 10 | 144 | 2 |
| Copepoda | COP | | 3 | | | 88 | |
| Calanoida | | | | | | 17 | |
| *Acartia tonsa* | | 24 | 5 | 17 | 32 | 15,882 | 214 |
| *Eurytemora affinis* | | | | 3 | 37 | 24 | |
| *Eurytemora hirundoides* | | | 1 | | 25 | | |
| *Eurytemora* sp. | | | | | | 83 | |
| *Osphranticum labronectum* | | | | 2 | | | |
| *Diaptomus* sp. | | 2 | 2 | 1 | 32 | 135 | |
| Cyclopoida | | 3 | 4 | 3 | 18 | 48 | |
| *Cyclops vernalis* | | 2 | | 1 | | | |
| *Cyclops* sp. | | 10 | | 2 | | | 16 |
| *Macrocyclops albidus* | | | | | 14 | | |
| *Euterpina acutifrons* | | | | | | | 1 |
| *Ergasilus* sp. | | | | | | 486 | |
| *Argulus* sp. | | | 4 | 5 | 14 | 83 | 15 |
| Cirripedia | NAU | | | | | 3 | 2 |
| Cirripedia | IMM | 3 | | 26 | | | |
| *Balanus improvisus* | | 3 | | | | | |
| *Melita nitida* | | | 1 | | | | |
| *Gammarus mucronatus* | | | 1 | | | | |
| *Corophium louisianum* | | | 1 | 1 | 1 | | |
| *Hyalella azteca* | | 1 | | | | | |
| Isopoda | | | | | 3 | | |
| *Edotea* sp. | | 4 | | | | | |
| Caridea | ZOE | 273 | 23 | 20 | 35 | 41 | 12 |
| *Palaemonetes pugio* | | | | 1 | | | |
| *Palaemonetes vulgaris* | | 2 | | | | | |
| *Penaeus aztecus* | JUV | 3 | | | | | |
| *Penaeus setiferus* | JUV | 4 | | | | | |

TABLE 7 – Continued

| Species | Stage | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| *Callianassa* sp. | ZOE | | | | 19 | 10 | |
| *Callinectes sapidus* | JUV | | | 2 | 18 | 20 | |
| *Rhithropanopeus harrisii* | ZOE | 1,235 | 1,161 | 291 | 1,559 | 343 | 441 |
| *Rhithropanopeus harrisii* | MEG | | | | 2 | 8 | |
| *Uca* sp. | ZOE | 10 | | 1 | 198 | 262 | |
| *Sesarma* sp. | ZOE | | | 2 | 34 | 26 | 4 |
| *Leydigia quadrangularis* | | | | | 3 | | |
| *Holopedium amazonicum* | | | 2 | 2 | 57 | 14 | |
| *Diaphanosoma brachyurum* | | 3 | 1 | 16 | 579 | 630 | |
| *Sida crystallina* | | 24 | 18 | | | 1 | |
| *Daphnia* sp. | | 43 | 10 | 6 | 3 | 3 | |
| *Ceriodaphnia megalops* | | 93 | | 1 | 1 | | |
| *Ceriodaphnia reticulata* | | 9 | 1 | 2 | 6 | | |
| *Moina micrura* | | | | | 5 | 37 | |
| *Moina affinis* | | 7 | 1 | 1 | 1 | 6 | |
| *Moina macrocopa* | | 7 | | | 1 | | |
| *Simocephalus vetulus* | | 7 | 42 | 5 | 80 | 1 | |
| *Simocephalus serrulatus* | | 2 | | | | | |
| *Simocephalus exspinosus* | | 2 | 31 | 3 | 3 | 1 | |
| *Bosmina* sp. | | | | | 1 | | |
| *Bosmina coregoni* | | | | | | 169 | |
| *Bosmina longirostris* | | | | | 1 | 15 | |
| *Eurycercus lamellatus* | | 26 | 7 | 2 | 4 | | |
| *Chydorus sphaericus* | | | | | 1 | | |
| *Ilyocryptus spinifer* | | | | | 5 | 49 | |
| *Bosminopsis deitersi* | | | | | | 14 | |
| *Moinodaphnia macleayii* | | | | | 51 | 9 | |
| Insecta | | 1 | | | | | 40 |
| Hemiptera | JUV | | 1 | 1 | 1 | 1 | |
| Corixidae | | | 1 | | | | |
| Corixidae | NYM | | | | 7 | | |
| Coleoptera | | | 2 | | | | |
| Coleoptera | LAR | | | | | 1 | 1 |
| *Berosus* sp. | LAR | | 1 | | | | |
| Dytiscidae | | | 1 | 1 | | | |
| Ephemeroptera | LAR | | | | 2 | | |
| Diptera | LAR | | | | 1 | | |
| Tendipedidae | LAR | | | | | 4 | 2 |

**TABLE 7 – Continued**

| Species | Stage | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| Osteichthyes | EGG | | | | | | 2 |
| Osteichthyes | LAR | 30 | 106 | 10 | 575 | 29 | 40 |
| Bothidae | LAR | | | | | 1 | |
| *Anchoa mitchilli* | JUV | | | | 20 | 6 | |
| *Micropogon undulatus* | JUV | 4 | | | | | |
| *Membras martinica* | | 1 | | | | | |
| *Syngnathus scovelli* | | | | | 1 | | |
| *Coscinodiscus* sp. | | | P** | P | P | P | |
| *Spirogyra* sp. | | P | | | | | |
| *Najas guadalupensis* | | | | | | P | |
| *Spirodela polyrhiza* | | | | P | | P | |
| *Lemna* sp. | | | | P | | P | |
| *Wolffia columbiana* | | P | P | P | P | P | P |
| *Wolffia floridana* | | P | P | P | P | P | |

*See Table 3
**See Table 3

enumerated the phytoplankton species collected over a five-month period. Zooplankters were not identified below the family level.

Estuarine-endemic species in area III plankton included the copepods *Eurytemora affinis*, *Eurytemora hirundoides* and *Acartia tonsa* and the meroplanktonic larvae of benthic invertebrates.

Plankton characteristic of freshwater lakes, ponds and rivers occurred in all months. Twenty-one species of cladocerans and several cyclopoid and diaptomid copepods were collected.

Zoeae of the xanthid crab *R. harrisii* dominated samples from April through the first June collections. These zoeae are seasonally abundant in the bays and bayous draining into Mississippi Sound and have been collected in fresh water in Simmons Bayou, Mississippi (personal communication, John Steen, Gulf Coast Research Laboratory). Adults of this species are common on the oyster reefs in Mississippi Sound.

With the exception of the euryhaline *A. tonsa*, copepods identified from area III were oligohaline or limnetic species. Representatives of the genus *Eurytemora* were present from May through June. Limnetic copepods were found in all months but were more numerous prior to the July samples. Species of *Diaptomus* and unidentified cyclopoids were the most abundant limnetic copepods. Small numbers of *Osphranticum labronectum, Cyclops vernalis,* and *Macrocyclops albidus* were taken. *Acartia tonsa* were abundant only in the second June samples. This species is adaptable to a wide range of temperature and salinity, and the near absence of this species through the first June samples suggests that the continuing flow of fresh water prevented the establishment of a population. Its importance in northern Gulf estuaries has been noted by Grice (1956), Cuzon du Rest (1963), Hopkins (1966), Gillespie (1971), and Perry and Christmas (1973).

Freshwater cladocerans were collected from April through June with species diversity greatest at the time of the first June samples. *Diaphanosoma brachyurum, Simocephalus vetulus* and *Bosmina coregoni* occurred in largest numbers.

Amphipods in area III samples were meso-oligohaline species (*Corophium louisianum, Melita nitida, Gammarus mucronatus*) with the exception of the freshwater-oligohaline *Hyallela azteca*.

*Summary Area III.* By combining a knowledge of the distribution of benthic adult invertebrates with preflood and postflood salinity data, the authors suggest that the endemic meroplankton in this area would, in all probability, largely be composed of the larval stages of brachyuran crabs and the zoeal larvae of caridean shrimp. *Acartia tonsa* would probably dominate the holoplankton. Assuming the above to be representative of the spring–summer plankton in area III, the changes in species composition brought about by the 1973 floodwaters are evident. Excluding the meroplanktonic larvae and juveniles of benthic invertebrates and juvenile fish, plankton collected in area III was characteristic of a freshwater-oligohaline fauna. The presence of insect larvae, mites, freshwater algae and vascular plants over the sampling period further demonstrates the influence of floodwaters.

## AREA IV

Five stations were located in area IV in western Mississippi Sound in the St. Louis Bay estuarine system (Figure 2, Table 1).

Shoreline marshes are dominated by *Juncus roemerianus.* Beaches in the vicinity of station 12 are manmade and maintained for public use. Beds of shoalgrass *Halodule beaudetti* existed in the area of station 11 in 1968 but have since disappeared (personal communication, Lionel Eleuterius, Gulf Coast Research Laboratory). Bottom sediments are primarily muddy to fine sands. Extensive oyster reefs are located in this portion of Mississippi Sound.

### *Hydrographic Data*

*Salinity.* Data for preflood and postflood salinities in area IV were furnished to the authors by personnel of the Fisheries Research and Development Section of the Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

Mean surface salinities for selected stations in the western sector of Mississippi Sound for the year 1968 were 11.8 ppt in April, increasing to 20.5 ppt in July.

Surface salinities for stations in area IV from April through July 1973 are shown in Table 8.

Salinities were low at all stations in April and during the first May sampling period. Surface salinities at station 11 were below 1.0 ppt through June increasing to 14.2 ppt in July. Station 12 showed a gradual increase in salinity through July. Open water stations (13, 14 and 15), more closely adjacent to Gulf influence, exhibited greater fluctuations in salinity. Salinities at these stations generally were greater than salinities at shore stations through June. Salinities at all stations rose in July.

TABLE 8.

**Hydrographic data and settled volume of plankton for stations in area IV.**

| Station | Parameter | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| 11 | ppt | 0.1 | 0.2 | 0.1 | 0.4 | 0.3 | 14.2 |
| 12 | ppt | 0.1 | 0.0 | 1.3 | 1.6 | 8.6 | 19.2 |
| 13 | ppt | 0.5 | 0.0 | 16.6 | 5.7 | 10.6 | 16.8 |
| 14 | ppt | 1.2 | 0.0 | 19.5 | 6.3 | 12.3 | 16.7 |
| 15 | ppt | 2.2 | 0.7 | 12.1 | 6.3 | 18.6 | 21.5 |
| 11 | °C | 25.2 | 26.7 | 27.1 | 29.4 | 31.6 | 31.2 |
| 12 | °C | 25.1 | 25.8 | 25.9 | 28.5 | 29.6 | 30.9 |
| 13 | °C | 24.2 | 24.4 | 26.4 | 28.3 | 29.0 | 29.8 |
| 14 | °C | 25.4 | 24.0 | 26.5 | 28.7 | 28.9 | 29.8 |
| 15 | °C | 25.2 | 24.1 | 25.7 | 29.0 | 28.1 | 29.7 |
| 11 | ml | *1.0 | *1.0 | *1.0 | 50.0 | *1.0 | 120.0 |
| 12 | ml | *1.0 | *1.0 | *1.0 | 1.0 | *1.0 | 15.0 |
| 13 | ml | *1.0 | *1.0 | *1.0 | 2.0 | 1.0 | 48.0 |
| 14 | ml | *1.0 | *1.0 | *1.0 | 2.0 | 14.0 | 1.0 |
| 15 | ml | *1.0 | 28.0 | *1.0 | *1.0 | 42.0 | 21.0 |

*less than

Postflood data for stations 12 and 15 were available for the years 1974, 1975 and 1976. Salinities in the vicinity of station 12 exhibited similar trends for the three years; low readings in April and May increasing through June and July. Postflood salinity means in 1974 in this area were similar to 1973 means and were slightly higher in 1975 and 1976. Readings for station 15, however, were consistently higher in postflood years.

The western end of Mississippi Sound is heavily influenced by drainage from the Pearl River and St. Louis Bay estuarine systems and depressed surface salinities are a natural occurrence for short periods of time. Circulation patterns in Mississippi Sound have recently been described by Eleuterius (1976). He noted that during periods of high river discharge the outflow from Pearl River passed through Grand Island Pass and turned southeast with some deflection to the northeast. Outflow from Jourdan and Wolf rivers empties into St. Louis Bay and follows the western shoreline of the Sound for some distance. These two systems operate to depress salinity levels in the western Sound during periods of peak river discharge.

*Temperature.* Surface temperatures for stations in area IV from April through July 1973 are shown in Table 8.

Temperatures between stations showed the greatest monthly variation (3.5°C) at the time of the second June samples. The lowest reading was taken at station 14 (24.0°C) in early May. The highest readings were 31.6°C and 31.2°C taken at station 11 in late June and July, respectively.

### *Biological Data*

*Settled Volume.* Settled volume of zooplankton by station in area IV is shown in Table 8.

Settled volumes were less than 1.0 ml in 17 of the 30 samples. High settled volumes associated with the capture of large numbers of the cnidarian *Liriope tetraphylla* occurred in July at stations 11 and 13. Crustacean larvae and copepods contributed heavily to the settled volume of plankton at stations 11 and 15 in early and late June, respectively. The settled volume of 21.0 ml in July at station 15 was composed primarily of *L. tetraphylla* and calanoid copepods.

*Zooplankton.* A systematic list of zooplankton collected in area IV is found in Table 9. Little published information exists on the composition of zooplankton communities in western Mississippi Sound. Perry (1975) seasonally monitored the occurrence of *Callinectes* sp. zoeae and megalopae at stations near the mouth of St. Louis Bay and the western tip of Cat Island. Burke (1975) sampled several stations in the western Sound during an investigation of the occurrence and seasonality of planktonic cnidarians in Mississippi waters. Personnel of the Fisheres Research and Development Section, Gulf Coast Research Laboratory, collected monthly plankton samples in Cat Island Pass from October 1973 through September 1976, removing larval fish and larvae and postlarvae of penaeid shrimp and portunid crabs for identification.

The composition of zooplankton at stations in area IV in April and May 1973 consisted primarily of freshwater-oligohaline species and the larvae of benthic estuarine invertebrates. Estuarine-endemic holoplankters were *Acartia tonsa* and *Eurytemora affinis.* The meroplankton was composed of the zoeal stages of xanthid and ocypodid crabs, caridean shrimp and unidentified decapods. *Callinectes* sp. megalopae and a postlarval stage of *Penaeus aztecus* were found at station 15. Barnacle nauplii were present in small numbers. Freshwater copepods and cladocerans were present in both months with species diversity and numbers greatest during the April sampling period. Identified copepods included *Osphranticum labronectum* and *Macrocyclops albidus.* Twelve species of cladocerans were recorded, the most abundant being *Ceriodaphnia megalops.*

TABLE 9.

Systematic list of zooplankton, area IV.

| Species | Stage | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| *Liriope tetraphylla* | MED* | | | | | | 8596 |
| *Bougainvillia carolinensis* | MED | | | | | | 85 |
| *Eucheilota* sp. | MED | | | | | | 8 |
| *Rhopalonema funerarium* | MED | | | | | | 8 |
| *Phialidium languidum* | MED | | | | | | 36 |
| *Eirene pyramidalis* | MED | | | | | | 6 |
| *Eutima variabilis* | MED | | | | | | 8 |
| Siphonophora | | | | | | | 2 |
| *Beroe ovata* | | | | | | | P** |
| *Mnemiopsis mccradyi* | | P | | | | | P |
| Pelecypoda | LAR | | | | 2 | 896 | |
| Gastropoda | LAR | 1 | | | 2 | 560 | 10 |
| Polychaeta | | | | | | 4 | 2 |
| Polychaeta | LAR | | | | | 272 | 2 |
| Hydracarina | | | 1 | 1 | 1 | | |
| Ostracoda | | | | | 130 | 363 | |
| Copepoda | NAU | | | | 200 | 1,632 | 8 |
| Copepoda | COP | | | | | 8,029 | |
| *Acartia tonsa* | | 2 | 190 | 58 | 1,550 | 215,084 | 199 |
| *Eurytemora affinis* | | 2 | | | | 4 | |
| *Eucalanus pileatus* | | | | | | 96 | 25 |
| *Osphranticum labronectum* | | 1 | | | | | |
| *Diaptomus* sp. | | 2 | 2 | | | | |
| *Labidocera aestiva* | | | | | 349 | 12,256 | 453 |
| *Centropages furcatus* | | | | | | 640 | 10 |
| *Paracalanus parvus* | | | | | | 1,280 | |
| Cyclopoida | | 2 | | 1 | 64 | 24 | |
| *Oithona brevicornis* | | | | | | 1,112 | |
| *Macrocyclops albidus* | | 3 | | | | | |
| *Corycaeus americanus* | | | | | | 224 | |
| *Corycaeus amazonicus* | | | | | | 160 | |
| *Ergasilus* sp. | | | | | | 20 | 1 |
| *Euterpina acutifrons* | | | 8 | | | 2,960 | |
| *Argulus* sp. | | 1 | | 1 | 4 | 5 | 1 |
| Cirripedia | NAU | 2 | | | 20 | 8,288 | 9 |
| Amphipoda | | | | | | 1 | |

Table 9 – Continued

| Species | Stage | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| *Cerapus* sp. | | 1 | | | | | |
| *Edotea montosa* | | | | | | 4 | |
| *Aegathoa oculata* | | | | 2 | 1 | 4 | |
| *Munna reynoldsi* | | | | | 1 | | |
| Decapoda | ZOE | | 6,544 | | | | |
| Caridea | ZOE | 8 | 8 | 92 | 62 | 133 | 19 |
| *Penaeus aztecus* | PST | 1 | | | 1 | 4 | |
| *Acetes carolinae* | PRO | | | | | | 9 |
| *Acetes carolinae* | MAS | | | | 2 | | |
| *Callianassa* sp. | ZOE | | | | 64 | | |
| *Upogebia affinis* | ZOE | | | | 16 | 96 | 12 |
| *Callinectes sapidus* | JUV | | | | 4 | 1 | |
| *Callinectes* sp. | ZOE | | | | | | 23 |
| *Callinectes* sp. | MEG | | | 5 | 1 | 5 | |
| *Rhithropanopeus harrisii* | ZOE | 209 | 134 | 143 | 1,313 | 69 | 26 |
| *Rhithropanopeus harrisii* | MEG | 1 | 1 | | | 2 | |
| *Uca* sp. | ZOE | 1 | | | 833 | 242 | 37 |
| *Uca* sp. | MEG | | | | | 1 | |
| *Sesarma* sp. | ZOE | | | | 31 | 1 | 40 |
| *Panopeus herbstii* | ZOE | | | | | | 16 |
| *Panopeus herbstii* | MEG | | | | | 1 | |
| *Panopeus occidentalis* | ZOE | | | | | | 4 |
| *Menippe mercenaria* | ZOE | | | | | | 4 |
| *Holopedium amazonicum* | | | | 2 | 4 | 2 | |
| *Diaphanosoma brachyurum* | | 1 | | | 1,581 | 118 | |
| *Sida crystallina* | | 6 | 1 | | | | |
| *Daphnia* sp. | | 35 | 4 | 3 | 2 | | |
| *Ceriodaphnia megalops* | | 51 | | | | | |
| *Ceriodaphnia reticulata* | | 5 | | 1 | | | |
| *Ceriodaphnia* sp. | | 1 | | | | | |
| *Moina micrura* | | | | | 20 | 6 | |
| *Moina affinis* | | 2 | | | | | |
| *Moina macrocopa* | | | | | | 12 | |
| *Simocephalus vetulus* | | 2 | | | 1 | | |
| *Simocephalus serrulatus* | | | | 1 | | | |
| *Simocephalus exspinosus* | | 18 | | 1 | | | |
| *Bosmina coregoni* | | | | | | 2 | |
| *Bosmina longirostris* | | | | | 1 | | |
| *Eurycercus lamellatus* | | 1 | | | | | |

**TABLE 9 – Continued**

| Species | Stage | April | [1]May | [2]May | [1]June | [2]June | July |
|---|---|---|---|---|---|---|---|
| *Ilyocryptus spinifer* | | | | 1 | 9 | 1 | |
| *Evadne* sp. | | | | | | 736 | |
| *Penilia avirostris* | | | | | | 96 | |
| *Podon* sp. | | | | | | 32 | |
| Insecta | | 2 | 8 | | | | |
| Corixidae | | | | 1 | | | |
| Coleoptera | | 1 | | | | | |
| Dytiscidae | | | 1 | | | | |
| Odonata | | | 1 | | | | |
| *Bugula neretina* | | | | | P | | |
| Ophiuroidea | OPH | | | | | | 2 |
| *Oikopleura* sp. | | | | | 8 | 996 | 8 |
| *Branchiostoma* sp. | | | | | | 1 | |
| *Sagitta enflata* | | | | | | 32 | 1 |
| *Sagitta tenuis* | | | | | | 228 | 18 |
| Osteichthyes | EGG | | | | 20 | 732 | 22 |
| Osteichthyes | LAR | 52 | 74 | 14 | 175 | 21 | 3 |
| Clupeiformes | LAR | | | | | 4 | |
| Elopidae | LEP | 1 | | | | | |
| Atherinidae | LAR | | | | | 14 | |
| *Membras martinica* | | 1 | | | | | |
| *Anchoa mitchilli* | JUV | | | | | 15 | |
| *Syngnathus* sp. | JUV | 1 | | | | | |
| *Syngnathus scovelli* | | 1 | | | | | |
| *Coscinodiscus* sp. | | | | P | P | P | |
| *Wolffia columbiana* | | P | | | P | | |
| *Wolffiella floridana* | | P | P | | P | | |

*See Table 3
**See Table 3

By June, the species composition of plankton in area IV more closely resembled a coastal estuarine-marine fauna, though limnetic and oligohaline species continued to dominate samples from areas near freshwater runoff until July. Neritic copepods appearing in June included *Labidocera aestiva, Centropages furcatus, Eucalanus pileatus, Corycaeus americanus* and *Corycaeus amazonicus.* Among the many hydromedusae collected in July were *Liriope tetraphylla, Bougainvillia carolinensis, Phialidium languidum, Eirene pyramidalis* and *Eutima variabilis.* Three species of marine cladocerans (*Podon* sp., *Evadne* sp., *Penilia avirostris*) and two coastal marine chaetognaths (*Sagitta tenuis, Sagitta enflata*) were identified. The larvacean *Oikopleura* sp. was present in both months.

The composition of the meroplankton also changed markedly in June and July with the appearance of larval stages of *Upogebia affinis, Acetes carolinae, Callianassa* sp., *Panopeus herbstii, Panopeus occidentalis* and *Menippe mercenaria.*

*Summary Area IV.* Plankton samples from the mouth of St. Louis Bay and Cat Island Pass for the period May through September 1971 were examined by the junior author. The general composition of the plankton near the mouth of St. Louis Bay was similar for the five months, with the holoplankton dominated by *A. tonsa* and the meroplankton by the zoeae of caridean shrimp and the xanthid crab *R. harrisii.* Assuming the above to be representative of the plankton in this area during the warmer months, changes in species composition at stations 11 and 12 brought about by the floodwaters include the addition of numerous oligohaline and limnetic genera.

Plankton samples from Cat Island Pass in 1971 exhibited an estuarine-marine fauna. Holoplanktonic species included the neritic copepods *L. aestiva* and *C. furcatus* and the euryhaline *A. tonsa.* Hydrozoan medusae were present. Perry (1975) found *Callinectes* sp. zoeae in samples from Cat Island Pass in the spring and summer. In addition to the larval stages of *Callinectes* sp., the larvae of *Trachypenaeus* sp., *Penaeus* sp., *Lolliguncula brevis* and numerous sciaenid and clupeid fishes have been identified from surface tows in Cat Island Pass (personal communication, Ronald Herring, Fisheries Research and Development Section, Gulf Coast Research Laboratory). These studies support the author's assumption that the species composition of the plankton in the Cat Island Pass area is typically estuarine-marine, thus the effect of floodwaters at stations nearest the influence of Gulf Waters was most evident in April and May. Recovery of the system began in June with the return of estuarine-marine species.

## AREA V

Seven stations were located in area V (Figure 3, Table 1). Stations 20 and 23 were in passes connecting shallow coastal lakes with the Gulf of Mexico. The remaining stations ranged as far as ten miles inland. Sampling in Terrebonne Parish was limited to a single trip in each of the following months: May, June and July. Station 23 was not visited in May.

Bottom sediments are primarily clayey silt (Barret et al. 1971b). Submerged vegetation is sparse, but some widgeongrass (*Ruppia maritima*) is present. The area is mainly saline marsh with oystergrass (*Spartina alterniflora*), saltgrass (*Distichlis spicata*) and wiregrass (*Spartina patens*) predominating (Chabreck 1972). Water depths are shallow in the lakes ranging from 2 to 5 feet. Depths in the passes vary from 17 to 20 feet.

### *Hydrographic Data*

*Salinity.* Preflood surface salinities at the mouth of Oyster Bayou in June and July 1968 were 15.3 and 16.4 ppt, respectively, with salinities from Bayou Grand Caillou ranging from 14.2 to 21.2 ppt from May through July 1969 (personal communication, Marilyn Gillespie, Louisiana Wildlife and Fisheries Commission). Under normal conditions, stations in area V would be expected to have some of the highest salinities of any of the areas studied. Salinity intrusion is occurring in Terrebonne Parish due to a multiplicity of factors: subsidence, the dredging of passes and the construction of canals.

Surface salinities for stations in area V from May through July 1973 are shown in Table 10.

**Table 10.**

**Hydrographic data and settled volume of plankton for stations in area V.**

| Station | Parameter | May | June | July |
|---|---|---|---|---|
| 17 | ppt | 0.3 | 0.1 | 0.0 |
| 18 | ppt | 0.1 | 0.1 | 0.0 |
| 19 | ppt | 0.3 | 3.3 | 2.0 |
| 20 | ppt | 0.7 | 3.8 | 7.9 |
| 21 | ppt | 1.5 | 3.2 | 0.3 |
| 22 | ppt | 2.5 | 6.1 | 1.4 |
| 23 | ppt | | 0.0 | 0.0 |
| 17 | °C | 26.0 | 29.8 | 32.6 |
| 18 | °C | 26.0 | 29.1 | 31.2 |
| 19 | °C | 26.5 | 29.8 | 30.3 |
| 20 | °C | 28.0 | 30.1 | 30.4 |
| 21 | °C | 27.0 | 30.5 | 30.3 |
| 22 | °C | 28.0 | 30.7 | 31.3 |
| 23 | °C | | 29.0 | 29.4 |
| 17 | ml | *1.0 | 2.0 | *1.0 |
| 18 | ml | *1.0 | *1.0 | *1.0 |
| 19 | ml | *1.0 | 2.0 | *1.0 |
| 20 | ml | *1.0 | 4.0 | *1.0 |
| 21 | ml | 2.0 | 1.0 | *1.0 |
| 22 | ml | 3.0 | 12.0 | *1.0 |
| 23 | ml | | *1.0 | *1.0 |

*less than

During the May sampling, salinities ranged from 0.1 to 2.5 ppt with the highest salinities recorded at the easternmost stations (21 and 22). Salinities were 0.1 ppt at the inland stations 17 and 18, and 0.0 ppt in Four League Bay (station 23) in June with salinities 3.2 or above at the remaining stations. In July, all salinities were 2.0 ppt or below with the exception of station 20. The pass at Grand Bayou du Large had a reading of 7.9 ppt, the highest salinity recorded in area V during the sampling period.

No postflood data were available on salinities from southwest Terrebonne parish.

*Temperature.* Surface temperatures for stations in area V for May through July 1973 are shown in Table 10. Temperatures appear to be within the normal range for the area.

***Biological Data***

*Settled Volume.* Settled volume of zooplankton by station in area V is shown in Table 10. Settled volume was less than 1.0 ml in 13 of the 20 samples. Large numbers of *Acartia tonsa* and *Uca* sp. zoeae contributed to the high settled volume at station 22 in June.

*Zooplankton.* A systematic list of zooplankton collected in area V is found in Table 11. Area data incorporating samples from Grand Pass des Ilettes, Bayou Grand Caillou, Grand Bayou du Large, Taylor's Bayou and Oyster Bayou in 1968–1969 were published in Gillespie (1971); however, the individual station data provided to the authors were not published. Her collections show the estuarine copepod *A. tonsa* and ctenophores to dominate the holoplankton. Other holoplankters such as *Labidocera aestiva* and *Eurytemora* sp. were occasionally present in small numbers. Marine calanoids, including species of *Eucalanus, Temora* and *Centropages*, entered the area in July although there was no distinct increase in salinity. The meroplankton was dominated by the larvae and postlarvae of decapods. Adult *Palaemonetes* sp. were collected in small numbers.

**Table 11.**

**Systematic list of zooplankton, area V.**

| Species | Stage | May | June | July |
|---|---|---|---|---|
| Pelecypoda | LAR* | 1 | | |
| Gastropoda | LAR | 6 | 369 | 10 |
| Polychaeta | | 1 | | |
| Polychaeta | LAR | 64 | 32 | |
| *Nereis* sp. | | | 6 | |
| Hydracarina | | 285 | 207 | 21 |
| Arachnida | | | | 2 |
| Ostracoda | | 142 | 5,415 | 5 |
| Copepoda | NAU | 64 | 18 | |
| Copepoda | COP | 3 | 145 | 3 |
| *Acartia tonsa* | | 3,359 | 118,176 | 88 |
| *Eurytemora affinis* | | 144 | 1 | |
| *Eurytemora hirundoides* | | 8 | | |
| *Eurytemora* sp. | | 8 | | |
| *Pseudodiaptomus cornutus* | | 11 | | |
| *Diaptomus* sp. | | 70 | 51 | 5 |
| *Labidocera aestiva* | | | 5 | |
| Harpacticoida | | | 1 | |
| *Euterpina acutifrons* | | 8 | 221 | |
| Cyclopoida | | 12 | 105 | |
| *Cyclops* sp. | | 89 | 36 | |
| *Ergasilus* sp. | | 23 | 444 | |
| *Halicyclops fosteri* | | 5 | | |
| *Argulus* sp. | | 37 | 100 | 19 |
| Cirripedia | NAU | 196 | 2,128 | |
| *Corophium* sp. | | 7 | | |
| *Corophium lacustre* | | | 14 | |
| *Corophium louisianum* | | | | 3 |

**TABLE 11 – Continued**

| Species | Stage | May | June | July |
|---|---|---|---|---|
| *Gammarus mucronatus* | | | | 3 |
| *Melita nitida* | | | 1 | |
| *Cerapus* sp. | | 2 | 2 | |
| Isopoda | | | | 15 |
| *Muna reynoldsi* | | | 1 | |
| *Edotea* sp. | | 34 | | |
| Caridea | ZOE | 464 | 230 | 70 |
| *Palaemonetes pugio* | | 3 | | |
| *Macrobrachium ohione* | | | | 1 |
| *Callinectes sapidus* | JUV | 7 | 28 | 2 |
| *Rhithropanopeus harrisii* | ZOE | 2,147 | 2,707 | 544 |
| *Rhithropanopeus harrisii* | MEG | 6 | 1 | |
| *Uca* sp. | ZOE | 1,563 | 28,346 | 34 |
| *Uca* sp. | MEG | | 11 | |
| *Sesarma* sp. | ZOE | 18 | 96 | 18 |
| *Penaeus aztecus* | PST | 13 | 1 | |
| *Callianassa* sp. | ZOE | 72 | | |
| *Upogebia affinis* | ZOE | 8 | | |
| *Diaphanosoma brachyurum* | | 27 | 54 | |
| *Moinodaphnia macleayii* | | | 2 | |
| *Ilyocryptus spinifer* | | 29 | 15 | 3 |
| *Sida crystallina* | | 8 | | |
| *Simocephalus vetulus* | | 16 | 2 | |
| *Simocephalus exspinosus* | | 7 | 3 | |
| *Moina micrura* | | | 2 | |
| *Moina affinis* | | | | 2 |
| *Moina macrocopa* | | 8 | | |
| *Ceriodaphnia megalops* | | 2 | 1 | |
| *Bosmina coregoni* | | 2 | 89 | |
| *Bosmina longirostris* | | | 5 | |
| Insecta | | 1 | | 5 |
| Tendipedidae | LAR | | | 1 |
| Trichoptera | LAR | | 1 | |
| Osteichthyes | LAR | 307 | 136 | 17 |
| *Anchoa mitchilli* | LAR | 2 | 1 | |
| *Anchoa mitchilli* | | 2 | | |
| *Adenia xenica* | | 3 | | |
| *Coscinodiscus* sp. | | | P** | |
| *Wolffia columbiana* | | P | | |
| *Wolffiella floridana* | | P | P | |
| *Myriophyllum* sp. | | | | P |
| *Najas* sp. | | | | P |
| *Lemna* sp. | | | | P |

*See Table 3
**See Table 3

Estuarine species dominated the May, June and July samples following the 1973 opening of the Morganza Floodway. *Acartia tonsa* was the most abundant holoplankter. The meroplankton was composed primarily of the zoeal stages of *Rhithropanopeus harrisii* and *Uca* sp. Numerous freshwater species were collected; however, none were present in large numbers. Members of the order Hydracarina were common as well as the freshwater copepods *Diaptomus* sp. and *Cyclops* sp. Twelve species of freshwater cladocerans were noted, with *Ilyocryptus spinifer, Diaphanosoma brachyurum* and *Simocephalus vetulus* the more numerous. Freshwater plants including duckweed (*Wolffiella floridana*) and water meal (*Wolffia columbiana*) occurred. Species diversity and abundance dropped in July.

*Summary of Area V.* Gillespie's data show the spring and summer plankton populations in area V to be dominated by the copepod *A. tonsa* and the meroplanktonic larvae of benthic invertebrates, with marine organisms entering the area in July. During the 1973 opening of the Morganza Floodway, freshwater copepods and cladocerans augmented the normal planktonic fauna. The usual July intrusion of marine species was not observed.

## GENERAL SUMMARY

The 1973 opening of the Bonnet Carré and Morganza floodways had a dramatic but short-term impact on plankton populations in adjacent coastal waters. Plankton populations in the estuarine waters of Mississippi and Louisiana are generally endemic assemblages, with the holoplankton dominated by *Acartia tonsa* and the meroplankton by the larvae of benthic crustaceans. Higher salinity portions of these estuarine areas normally show an increase in marine forms as salinities rise through the summer. During and subsequent to the floodway openings, however, the normal estuarine populations were augmented by the addition of numerous freshwater-oligohaline species. As salinities returned to normal levels, these forms were eliminated.

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